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Abstracts of Papers to Appear in Future Issues

NUMERICAL SIMULATION OF SHOCK–CYLINDER INTERACTIONS. I. RESOLUTION, Wai Sun Don and Carl B. Quillen, *Division of Applied Mathematics, Brown University, Providence, Rhode Island 02912, U.S.A.*

We apply two different high-order shock capturing schemes to the study of a two-dimensional unsteady inviscid flow. In particular, we study the interaction of a planar shock with a cylindrical volume of a light gas (helium or hydrogen) contained in air. The two schemes used are the Chebyshev collocation method and the ENO finite difference scheme of Osher and Shu, and they are applied to a physical model consisting of the Euler equations with a real gas equation of state and multiple chemical species. The parallel implementation and low-level coding of the ENO scheme on the Thinking Machines CM-5 results in much higher performance than is possible on a standard serial or vector machine. The ENO code is compared with an existing experimental result and agrees well with it. The results of spectral and ENO calculations are then compared with each other at different resolutions for a Mach 2 interaction. The spectral scheme, though highly oscillatory in nature for discontinuous problems (Gibbs), accurately predicts both large and fine scale structures of the interaction between the shock and the light gas cylinder. Good results can be recovered from the spectral results by post-processing the raw numerical data to remove the Gibbs phenomena. These results are compared with the ENO schemes. The comparison is progressively better as the grid refinement and numerical order of the ENO scheme is increased. This demonstrates definitively the applicability and value of high order schemes to flows with shocks and complicated non-linear physics.

EXTENSION OF THE PIECEWISE PARABOLIC METHOD TO ONE-DIMENSIONAL RELATIVISTIC HYDRODYNAMICS. José Mª Martí and Ewald Müller, *Max-Planck-Institut für Astrophysik, Karl-Schwarzschild-Strasse 1, 85740 Garching bei München, Germany.*

An extension to 1D relativistic hydrodynamics of the piecewise parabolic method (PPM) of Colella and Woodward using an exact relativistic Riemann solver is presented. Results of several tests involving ultrarelativistic flows, strong shocks, and interacting discontinuities are shown. A comparison with Godunov's method demonstrates that the main features of PPM are retained in our relativistic version.

SPECTRAL ANALYSIS OF RESISTIVE MHD IN TOROIDAL GEOMETRY. A. R. Schellhase and R. G. Storer, *Department of Physics, The Flinders University of South Australia, G.P.O. Box 2100, Adelaide 5001, Australia.*

A code, SPECTOR, has been developed to determine the complete spectrum (both stable and unstable modes) for a resistive plasma in toroidal geometry described by the linearized, compressible, magnetohydrodynamic, single fluid equations. The structure of the code is explained and comparisons with other codes are presented which test its validity. Some applications to both cylindrical and tokamak-like plasmas are presented to illustrate the scope of the code particularly for the stable part of the spectrum. A study is made of the effect of resistivity on a typical toroidal Alfvén eigenmode.

STABLE CONSERVATIVE MULTIDOMAIN TREATMENTS FOR IMPLICIT EULER SOLVERS. A. Lerat and Z. N. Wu, *SINUMEF Laboratory, Ecole Nationale Supérieure d'Arts et Métiers 151 bd de l'Hôpital, 75013 Paris, France.*

Multidomain treatments are studied in order to solve the steady compressible Euler equations using implicit time-dependent finite volume methods on block-structured grids. Unconditionally GKS-stable and conservative treatments are proposed for continuous and discontinuous 1D matchings and extended to 2D patched grids. Efficiency of the present interface conditions is demonstrated through transonic flow calculations over single- and two-element airfoils.

A STABILITY ANALYSIS ON BECK'S PROCEDURE FOR INVERSE HEAT CONDUCTION PROBLEMS. Jun Liu, *Fluides, Automatique et Systèmes Thermiques, URA CNRS-UPMC-UPS N° 871, Bâtiment 502, Campus Universitaire, 91405 Orsay Cédex, France.*

The sequential function specification method proposed first by Beck is considered as one of the most efficient methods for the inverse heat conduction problem (IHCP) which is extremely ill-posed and time-dependent. This method determines an "inverse solution" advancing in a sequential fashion in time. The values estimated at any given time depend on the solution obtained previously. The main question connected with this method is the stability; *i.e.*, the cumulative error in the solution must remain bounded at all times. Since the first paper of Beck in 1970, few theoretical stability analyses have been studied in the literature. The aim of this paper is to find the conditions under which this method is stable irrespective of the data measurements. For a 1D linear IHCP, we try to construct a sequence

$$X_1 = 1, \qquad X_j = \sum_{i=1}^{j-1} \alpha_{j-i+1} X_i, \quad j \geq 2, \tag{1}$$

such that the coefficients α_i are independent of the data measured and the convergence of the series $\sum_{i=1}^{\infty} |X_i|$ guarantees the stability of the method. In other words, we need to find an adequate condition on α_i such that $\sum_{i=1}^{\infty} |X_i|$ is convergent, implying that the method is stable. The values of α_i depend on the discretization size h of the function to be determined $q(t)$ and the sliding time horizon (or future time interval) τ of the method. The range of values of h and τ which give the values of α_i such that the series $\sum_{i=1}^{\infty} |X_i|$ is convergent are established numerically. Under the stability condition, an error estimation of the Beck's method is derived. The approach presented could be also applied to the multidimensional IHCPs, in which the coefficients α_i and X_i are no longer scalar but become square matrices.

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